



## Tomorrow's Energy Today

*for Cities and Counties*

*Municipal transit authorities will soon begin to replace buses that use traditional diesel fuel with buses that use alternative fuels that are less polluting.*

# Catch a Cleaner Bus

*Urban buses using conventional diesel engines will soon have to reduce emissions by as much as 50%. To meet strict new emissions standards, many municipal transit authorities have decided to run buses on alternative fuels.*

Have you ever been stuck in traffic behind an old bus? While you held your breath, you probably weren't thinking about how urban buses help reduce overall air pollution. The use of buses reduces the number of cars on the road and the pollution that these cars generate. One bus, depending on its size, can transport the number of people who would travel in six to 12 cars.

Most of today's buses run on diesel fuel, a petroleum product less refined than gasoline. Conventional diesel engines sometimes produce a thick,

black exhaust smoke containing particulates, which consist primarily of unburned elements of the diesel fuel. According to the U.S. Environmental Protection Agency (EPA), these particulates are harmful to human health. EPA classifies diesel particulates as a probable human carcinogen and recently released a draft study that links diesel fuel exhaust to cancer.

### *The Clean Air Act Amendments Target Diesel Emissions*

The Clean Air Act Amendments of 1990 require urban buses to meet stringent new particulate emission standards. Because urban buses operate almost exclusively in our populated and often polluted cities, these standards were set even lower than those affecting diesel trucks. In addition, EPA has set stringent new standards for emissions of smog-forming oxides of nitrogen from new buses and trucks.

EPA is implementing two new programs to reduce urban bus particulate emissions: a standard for new bus engines, and a retrofit program for older buses in cities with populations greater than 750,000, beginning



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*Beginning in 1995,  
older buses will have  
to meet EPA emissions  
standards when their  
engines are rebuilt.*

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in 1995. The retrofit program is important because bus engines operate for many years and are often rebuilt more than once before they are retired from service.

Meeting the new EPA standards poses a challenge for municipal transit authorities. Older, conventional diesel engines do not meet the new EPA emissions standards (without specialized equipment), and most experts believe that municipal transit authorities have two options for maintaining compliance.

One option is to buy advanced diesel engines that burn a more highly refined diesel fuel and generate fewer emissions, or retrofit new technology onto old buses to reduce emissions. Advanced diesel engines have emissions-reducing devices such as catalytic converters and particle traps as part of the exhaust-handling equipment of the engine. Particle traps filter particulates out of the stream of hot exhaust gases onto screens made of ceramic material. These traps periodically burn the collected particulates off of the screens.

A more attractive option may be to buy new bus engines that run on alternative fuels, including electricity, ethanol, methanol, propane, or natural gas. In many cases, alternative fuel vehicles whose engines are properly maintained produce fewer polluting emissions than do vehicles using diesel fuel.

Transit authorities may implement a combination of the two options, involving some diesel and some alternative fuel buses.

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## *The Bus Industry Gears for Change*

Engine manufacturers are working quickly to develop alternative engines that meet EPA standards. In fact, engine manufacturers now offer a number of heavy-duty engines that run on alternative fuels.

In general, bus fleets are well suited to alternative fuels. Buses are used on routes that require a known range per tank of fuel. Buses have well-defined space and weight requirements for accommodating passengers. And transit buses are maintained in a single maintenance facility that can conveniently service alternative fuel vehicles.

Nevertheless, no single engine/fuel combination has yet proven to be the best for all transit applications. Local factors, such as the availability of the alternative fuel, the size of the particular bus fleet, and specific environmental requirements, often help local transit officials determine which clean-air technology is their best choice. In addition, cost and budget factors, availability of refueling stations, maintenance needs, and engine performance must be considered before deciding which new engine/fuel combination is best for each locale.

Local transit agencies around the country are changing to different clean-air bus technologies to improve air quality and meet EPA emissions requirements.

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## Chattanooga Goes Electric

The Chattanooga, Tennessee, transit authority is involved in one of the world's largest experiments using electric buses. Since April 1992, the Chattanooga Area Rapid Transit Authority (CARTA) has operated two buses on a 1.5-mile (2.4-kilometer) shuttle route that connects the train station with the downtown area. The buses use electric motors powered by batteries. The batteries can be charged at night when the utility electricity rates are lowest.

The limited storage capacity of today's batteries often determines the range of the buses and precludes auxiliary loads such as heating and air conditioning. Battery technology now being developed will be capable of supporting such auxiliary loads in the future. The two CARTA buses, which are prototype models, eliminate the need for auxiliary air conditioning by leaving the windows open in the summer. According to Tom Dugan, CARTA's director, passengers find the open-air design comfortable in the summer on routes that go short distances at low speeds.



Chattanooga, Tennessee, now has the largest fleet of electric (battery-powered) buses in the world.



Peoria, Illinois, operates a fleet of 14 buses powered by ethanol.

Dugan says the public's reaction to the buses has been so positive that CARTA has ordered 12 new electric buses. These were delivered in late 1993, and an additional 10 buses will be delivered to add to CARTA's fleet of 55 diesel buses. The electric buses will be used on normal, revenue-producing routes. Claims Dugan, "Chattanooga is committed to electric-powered transit vehicles."

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## Peoria Chooses Ethanol

Since October 1992, Peoria, Illinois, has been operating the world's largest bus fleet fueled by ethanol. The district has set up a new maintenance facility for the ethanol buses and trained mechanics in the appropriate maintenance procedures, which are slightly different from those for diesel buses.

So far, the Greater Peoria Mass Transit District has accumulated data on 522,000 miles (842,000 kilometers) of bus operation on all routes in the city. According to George Stout, Director of Maintenance for the transit district, the buses have performed well. He claims, "They have plenty of pep. We like them enough that we are considering buying more." Stout claims that the public has responded very favorably to the new buses. He says, "There is no smoke at all from the ethanol buses. We like doing our part to preserve the environment."



## Miami Tries Methanol

Since May 1992, the Metro Dade Transit Agency has run five buses on methanol. These bus engines run on 100% methanol and were among the first methanol engines to become commercially available. The transit agency, which serves the greater Miami area, is collecting data on methanol buses as part of a comprehensive experiment with clean-bus technologies. Metro Dade has now accumulated data on more than 100,000 miles (160,000 kilometers) of operation of the methanol engines. Metro Dade is trying to determine which technology is the best for complying with EPA standards in the semitropical environment of south Florida.

According to Fred Shields, who oversees the methanol project for the authority, "Metro Dade Transit wants to demonstrate that we care and are doing something about the environment." As a result, he states that Metro Dade has taken extensive precautions to ensure that its operations are safe for the environment and for maintenance workers. For example, Metro Dade has trained maintenance personnel to handle methanol safely. The work stations are open-air style with the garage doors left open whenever work is taking place on methanol engines.



Barry Flax/Metro Dade Transit Agency

Manistee County, Michigan, has run 20 of its 23 buses on propane since 1986.



Tillolson Photo

As part of a larger experiment with buses powered by alternative fuels, Metro Dade Transit Agency has operated five buses on methanol since May 1992 to compare their performance to that of the agency's conventional buses.

## Michigan Buses Fueled by Propane

For the last 10 years, Manistee County, in Michigan's Lower Peninsula, has operated a fleet of buses on propane. Today, 20 of its 23 buses run on propane. Richard Strevey, the county's fleet manager, states, "Propane is a very cost-effective fuel. I have yet to see the downside of using propane."

Although the primary reason that the county chose propane was the low cost of the fuel, there have been operation and maintenance cost reductions as well. Says General Manager Strevey, "The propane engines run cleaner than the diesel engines, so we have much less maintenance on the engines." For as long as Strevey has managed the fleet, there hasn't been a single engine failure on the propane buses.

Strevey states that although Manistee County does not have air quality problems, he sees environmental benefits from using propane. The riders appreciate the fact that the buses have clean exhaust.

## *Houston Commits to Natural Gas*

Since 1991, the Metropolitan Transit Authority of Houston (Metro) has run a pilot program of 14 buses on liquefied natural gas (LNG). These buses were first-of-a-kind units that operate on a mixture of LNG and diesel. (The diesel is used as a "pilot" ignitor of the vaporized LNG, or as a backup if the LNG fuel is not available.) Altogether, Metro has accumulated data on 600,000 miles (1,000,000 kilometers) of bus operation on revenue-producing routes.

In March 1993, because of the pilot program success, Metro began operating a total of 42 buses on LNG and has continued to add to the fleet. Metro now has the largest fleet of LNG-fueled buses in the world.

According to Larry Luttrell, who manages the alternate fuels program for Metro, program staff chose LNG

because it suited Houston's particular operations. Natural gas is readily available in Texas at very reasonable prices. In fact, Larry says Metro's fuel costs for LNG and diesel buses are approximately the same.

"Natural gas in liquid form is more convenient than in gaseous form for Metro's large operation. Buses can be refueled with LNG in the same amount of time as with diesel. And the fuel tanks with LNG weigh less than those with CNG [compressed natural gas], allowing the buses to carry more passengers without being overloaded," says Luttrell. On the other hand, LNG must be stored at very low temperatures to maintain liquid form. As a result, Houston's buses have highly insulated, cryogenic fuel tanks that will keep the gas cold for 7 to 8 days. Luttrell states further, "With the use of cryogenics, we have moved bus technology into the 21st century."

## *A New DOE Program Demonstrates Alternative Fuel Buses*

The U.S. Department of Energy (DOE) is providing cost-sharing funds for local transit authorities and school districts that purchase alternative fuel buses. This \$90 million program, created by the Energy Policy Act of 1992, authorizes DOE to provide funds to governments of communities larger than 100,000 people for joint ventures with transit authorities to purchase alternative fuel buses.

In addition, DOE has a program to help local school districts purchase alternative fuel buses. The purpose of this program is to test the performance of school buses operating on alternative fuels in different climates and operating conditions. Under this program, DOE pays for the difference between the purchase cost of an alternative fuel school bus and that of a conventional bus (i.e., the incremental cost). The program is administered through the state energy offices. For more information, contact your state energy office.

### *Performance Data Are Available*

The U.S. Department of Energy maintains data on the performance of urban transit buses operating on alternative fuels. Information can be obtained on fuel economy, maintenance costs, and safety requirements necessary for using alternative fuel vehicles. The data are available by calling the National Alternative Fuels Hotline: (800) 423-1DOE.



Metropolitan Transit Authority

*Houston, Texas, operates a total of 42 buses on liquefied natural gas (LNG). The city chose LNG because the exhaust is very clean, and natural gas is relatively inexpensive in Texas.*

## For More Information

### Urban Consortium Energy Task Force

Public Technology, Inc.  
1301 Pennsylvania Avenue, NW  
Washington, DC 20004  
(202) 626-2400

#### *A Guidebook for Alternately Fueled Vehicles*

The UCETF works extensively with local governments to document and help share their experiences and is an excellent information and technical assistance resource.

### American Public Works Association

2345 Grand Boulevard, Suite 500  
Kansas City, MO 64108  
(816) 472-6100

#### *Alternative Fuels: What You Need to Know*

### Community Transportation Association of America

725 15th Street, NW, Suite 900  
Washington, DC 20005

### National Alternative Fuels Hotline

U.S. Department of Energy  
Alternative Fuels Program  
1925 North Lynn Street  
Arlington, VA 22209  
(800) 423-1DOE

### Electric Power Research Institute

Electric Transport Program  
P.O. Box 10412  
Palo Alto, CA 94303  
(415) 855-2981

### Mr. Shang Hsiung

Federal Transit Administration  
400 7th Street, SW  
Washington, DC 20590  
(202) 366-0241

### American Gas Association

1515 Wilson Boulevard  
Arlington, VA 22209  
(703) 841-8660

### California Energy Commission

Transportation Technology and  
Fuels Office  
1516 Ninth Street, MS-41  
Sacramento, CA 95814  
(916) 654-4634

### Mr. Phil Carlson

Environmental Protection Agency  
2565 Plymouth Road  
Ann Arbor, MI 48105  
(313) 668-4270

Mr. Carlson can provide additional information on provisions of the Clean Air Act Amendments of 1990 that affect buses.

### Energy Efficiency and Renewable Energy Clearinghouse

P.O. Box 3048  
Merrifield, VA 22116  
(800) 363-3732

EREC, funded by the U.S. Department of Energy, provides information on renewable energy and energy efficiency technologies.

## DOE Regional Support Offices

The DOE Office of Energy Efficiency and Renewable Energy reaches out to the states and private industry through a network of regional support offices. Contact your DOE regional support office for information on energy efficiency and renewable energy technologies.

### Atlanta DOE Support Office

730 Peachtree Street, NE, Suite 876  
Atlanta, GA 30308  
(404) 347-2837  
(Serves: AL, AR, FL, GA, KY, MS, NC, PR, SC, TN; Territory, VI)

### Boston DOE Support Office

One Congress Street, 11th Floor  
Boston, MA 02114  
(617) 565-9700  
(Serves: CT, MA, ME, NH, NY, RI, VT)

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Golden, CO 80401  
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### Philadelphia DOE Support Office

1880 JFK Boulevard, Suite 501  
Philadelphia, PA 19103  
(215) 656-6950  
(Serves: DC, DE, MD, NJ, PA, VA, WV)

### Seattle DOE Support Office

800 Fifth Avenue, Suite 3950  
Seattle, WA 98104  
(206) 553-1004  
(Serves: AK, AZ, CA, HI, ID, NV, OR, WA)



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